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ABSTRACT

This seven-section report examines the pension-related behavior of older public employees, particularly California teachers. Section I introduces the benefit option situation. Section II surveys previous studies focusing on the relationship between Social Security wealth and the probability of retirement. Section III describes the California State Teachers' Retirement System, notes incentives offered by local districts, and suggests trends toward early retirement. Section IV outlines a theoretical framework that views the employee as a "utility maximizer." Section V presents the approach taken and defines variables, several of which were not included in previous studies: eligibility for other pensions, spouse's earnings, and job characteristics. Section VI discusses results, including the tendency of the private pensions to induce earlier retirement, and the association of good health with delayed retirement. A final section offers implications, followed by a bibliography and appendix. (KS)

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Project Report No. 84-A9

THE EFFECT OF PENSION WEALTH ON THE AGE OF RETIREMENT

Stephen I. Kutner

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May 1984

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Abstract

This paper presents a quantitative assessment of the effect of pension benefits on the retirement behavior of older workers, with particular reference to the California State Teachers' Retirement Plan. If higher pension benefits induce individuals to retire earlier there may be a real opportunity to decrease the average age of retirement. This study has four basic findings:

1. The effect of increasing pension wealth operates to encourage earlier retirement: a $5,000 increase in pension wealth decreases the average age of retirement by 0.23 years.

2. The effects of Social Security and private pension eligibility show no apparent and marginally insignificant results, respectively.

3. Good health is associated with delayed retirement.

4. The effect of post-retirement earnings is to encourage earlier retirement: a $1,000 increase in post-pension earnings decreases the average age of retirement by 0.15 years.

I. Introduction.

Pension benefits are an important element of employee compensation and participation in an employee pension plan will influence the retirement decisions of older workers. In an earnings based defined-benefit plan, the employer guarantees benefits to workers who meet specified eligibility criteria. In general, employees have some choice concerning age of retirement and the annual pension benefit they receive will depend on this decision.

Many employers offer an early retirement option as part of their benefit plan. Typically, this option allows an employee to retire before reaching the plan's normal retirement age. In most cases, the early retirement option also changes the percentage of average earnings per year of service. This benefit option has been widely adopted by employers operating under seniority or tenure work rules because it enables employers to manage the size and age composition of their employee populations without having to challenge the seniority rights of older employees.

Although considerable resources have been devoted to the study of retirement decisions of workers in the United States, most of these studies have concentrated on the effects of provisions of the Social Security system. This paper extends the pension literature to state-administered public employee pension plans. It presents a quantitative assessment of the effect of

pension benefits on the retirement behavior of older workers, with particular reference to the California State Teachers' Retirement Plan.

In Section II, a brief survey is presented of the Social Security pension literature concerned with the determinants of retirement. A critical, and still unresolved issue is the question of the importance of pension wealth in the individual's retirement decision.

Section III begins with a description of the California State Teachers' Retirement System (STRS). Trend data are given on the changing characteristics of retired members. One of the most important observations is the decline by almost one year in the average age of retirement since 1972.

Section IV presents the theoretical considerations in modeling the age of retirement decision. The model specified in this section views the individual as a utility maximizer selecting an optimal age of retirement.

Section V describes construction of the data set, definitions of variables included in the estimated age of retirement equation, and method of estimation. The micro-data set used for this study contains several variables not included in previous studies: eligibility for other public and private pensions, spouse's earnings, job characteristics, and predicted earnings in a post-retirement occupation.

In Section VI, the empirical results are presented. The most important finding is a significant negative relationship between age of retirement and STRS pension wealth.

In Section VII, simulation results are presented that compare the effects of alternative pension policies on the age of retirement. It is shown that if the actuarial reduction factor for early retirement were eliminated, then the average age of retirement would decrease by approximately nine months. Alternatively stated, if pension wealth were increased by an amount equivalent to one year of earnings, then the average age of retirement would fall by approximately nine months.

II. Previous Studies.

Early studies of retirement behavior focused on the influence of health-related work limitations. Steiner and Dorfman (1957) analyzed a Special 1952 Follow-Up Survey of the Aged to the Current Population Survey. They found that in 79 percent of all voluntary retirements, poor health was the reason given. Wentworth (1968) summarized a series of Social Security Administration Surveys of the Aged conducted between 1941 and 1963. These studies revealed that 88 percent of the beneficiaries queried in the 1941-1951 surveys and 74 percent of those in the 1963 survey had their jobs terminated by their employer or were forced to quit because of ill health. A more recent result reported by Bixby (1974)- based on data from the 1968 Survey of

Newly Entitled Beneficiaries -indicates that health was the most frequently given reason for leaving a last job by surveyed men who were not working. The usefulness and strength of these results has been challenged frequently by critics who argue that health is a socially acceptable reason for retirement and the reported health effects overstate the true effects of health on retirement decisions.

In recent years researchers have focused on the role of economic factors. A key question in empirical work has been whether poor health or potential earnings and retirement benefits is the critical factor influencing retirement. The following summary reports the findings of seven econometric studies that have examined the effect of Social Security wealth on retirement behavior. [1]

A summary of the key characteristics of each study is found in the appendix. Table 1 displays the findings on health effects. The findings of those studies containing data on health-limitations are consistent. That is, poor health increases the probability of accepting a pension or retiring. It should be noted that these studies all suffer to some extent from the problem caused by a lack of objective data on health status.

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1. For additional studies that have examined the determinants of retirement behavior, see Burkhauser (1977); Boskin (1977); Hall and Johnson (1980); Burbidge and Robb (1980).

Table 2 contains a summary of findings of the effects of public and private pensions. The results for Social Security wealth are mixed. Gordon, Blinder and Wise conclude that Social Security wealth has a negligible effect on retirement probabilities. This conclusion has been challenged by Burkhauser and Turner (1981) who argue that Blinder, Gordon and Wise failed to account for the separate entitlement of spouses to their own Social Security benefits, and did not correctly account for the cost of living adjustment factor. The remaining studies find a positive relationship between Social Security wealth and the probability of retirement; however, the magnitude of the reported findings vary by age and sex.

TABLE 1

Findings on Health Effects

Study	Variable Definition	Findings[a]
Boskin and Hurd	Dummy variable taking value of one if health limitation	Health limitation incr. prob. of ret. (semi-ret.) from .115 to .212 (.126)
Burtless and Hausman	None	-----
Clark and Johnson	Duke Health Index	Mild health lowers prob. of husband (wife) being in labor force by 9.05 (1.38(*)) points
Gordon, Blinder and Wise	Dummy variable taking value of one if health worse than others of same age	Poor health incr. prob. of being ret. 10-18%
Mitchell and Fields	None	-----
Pellechio	None	-----
Quinn	Dummy variable taking value of one if health limitation	Persons with health limitation have a participation prob. over 20 points lower than those without

[a] Findings are statistically significant unless otherwise indicated by *.

TABLE 2

Findings on Social Security Wealth Effect

Study	Variable Definition	Findings
Boskin and Hurd	Actual or est. Soc. Sec. annual benefit for household	For complete ret. (semiret.) state, a thousand dollar incr. in benefits leads to an 8% (2%) incr. (decr.)
Burtless and Hausman	Soc. Sec replacement rate is ratio of benefits eligible in 1977 divided by imputed 1977 wage	For ret. state, the longer the wait until Soc. Sec. benefits begin, the smaller the likelihood of ret.
		For federal employ. state, women (men) eligible to receive Soc. Sec. are more likely to leave (remain in) federal service than women (men) not entitled to Soc. Sec.
Clark and Johnson	Soc. Sec wealth of husband (wife)	Husband's (wife's) Soc. Sec. wealth incr. (decr.) his participation by 0.85 (0.28) points
		Wife's (husband's) Soc. Sec. wealth incr. (decr.) her participation by 5.15 (0.89) points

TABLE 2--Continued

Study	Variable Definition	Findings
Gordon, Blinder and Wise	Soc. Sec. wealth as of age 65 divided by pres. value of gross annual imputed earnings from current age to 67	Incr. in Soc. Sec. wealth has a negligible effect on ret. prob.
Mitchell and Fields	Pres. value of income at earliest possible ret. age	A 10% incr. in Soc. Sec. benefits leads to a less than one month reduction in age of ret.
Pellechio	Pres. value of benefits assuming full ret.	When Soc. Sec wealth incr. by two stand. dev. the ret. prob. rises by 0.15 (0.22) relative to 0.41 (0.78) rate for 62-64 (65-70) yr. olds For 60-61 yr. olds, the effect was small and insig.
Quinn	Soc. Sec. elig. dummy	Lowers participation prob. by 11.3 points

III. Background.

What are the incentives encouraging teachers or administrators in California's public school system to leave their jobs? Is there any evidence that professional staff are retiring at earlier ages? To answer the first question, a description of the California State Teachers' Retirement plan is given. This is followed by a discussion of retirement incentives offered by local school districts. Finally, this section concludes with a presentation of trend data on the characteristics of new retirees.

Any certificated person employed in the public schools of California in grades pre-kindergarten through 14 is eligible for membership in the State Teachers' Retirement System (STRS). STRS offers a defined-benefit plan (with an employee contribution). Normal service retirement with full benefits is at age 60 and 5 years of credited California service. The service retirement allowance is based on 2 percent of final compensation for each year of credited service, where final compensation is defined as the average salary earnable for the highest 3 consecutive years of credited California service. There is no maximum limitation on the service retirement allowance.

Eligibility for early retirement occurs at age 55 with 5 years' credited California service. There is an actuarial

adjustment for early retirement; that is, a 1/2 percent reduction in the normal retirement allowance for each full month younger than age 60. For example, the benefit formula for a member retiring at age 55 (60 months early) is 1.4 percent of final compensation for each year of credited service. In this case, the early retirement benefit allowance is 70 percent (1.4/2.0) of the normal retirement allowance.

For members retiring after age 60, there is a late retirement adjustment. This adjustment allows for additional service credit without an actuarial improvement.

STRS does allow a member to retire and accept a consulting contract from their local school district. The maximum amount earnable under this contract is $5,000 per year. There are no limitations on employment in public schools outside California, or in private schools (inside or outside the State). Retirees cannot be employed in a classified position in the California public school system.

There are two additional provisions of STRS that are important for the decision to accept a pension. First, the post-retirement adjustment or improvement factor modifies the service retirement allowance by an annual 2 percent increase applied to the base amount of all continuing benefits. Second, STRS is not integrated with Social Security.

To promote early retirement, local school districts offer incentives beyond those provided under the statewide plan. Two of the most common incentives are district-paid health and welfare benefits and post-retirement consulting contracts (as allowed under STRS). In 1979, approximately 26 percent of California's school districts offered post-retirement consulting contracts, while 31 percent paid for employees' health benefits after they left their jobs. A small number of districts, approximately 3 percent, provided career and retirement counseling for district employees.

Table 3 provides limited evidence of a trend toward earlier retirement. Between 1973 and 1979 the average age at retirement declined from 61.5 to 60.6 years of age. Table 4 provides data on the retirement experience of STRS members between 55 and 65 years of age for the period 1975-1979. Each cell entry represents a rate of retirement expressed as the number of members of the specified sex and age group retiring per 1,000 members in the plan with the same characteristics for the given year. For example, the cell entry for males 55 years of age in 1975 is 41 (per 1,000 members in the plan). This table provides evidence of a trend toward early retirement. For example, the rate of retirement for 55 year old males (females) increased from 41 (73) to 112 (106) between 1975 and 1979. This represents a 173 (45) percent increase. For 56 year old males, the rate increased by 129 (45) percent. This table reveals increases in rates of retirement through age 62. For ages 63 through 65, rates of retirement are decreasing, with the exception of 63 year old females.

TABLE 3

Characteristics of New Service Retirants

Fiscal Year	Average Age at Retirement	Average Years of Service Credit	Average Allowance Payable. Nominal Dollars	Constant Dollars
1973	61.3	22.5	6,144	4,728
1974	61.8	21.3	6,240	4,332
1975	61.9	21.6	6,696	4,236
1976	61.9	21.4	7,088	4,200
1977	61.3	21.2	8,136	4,188
1978	60.7	22.1	8,136	4,188
1979	60.6	21.9	8,436	3,924

Note:

Average final compensation data are computed using the Consumer Index for California (1967=100)

Source:

66th Annual Administrative and Financial Report, State of California) State Teachers' Retirement System (Sacramento, California 1979, p. 139.

TABLE 4

Retirement Experience of STRS Members

Age	1975	1976	1977	1978	1979
	Males (annual rate per thousand)				
55	41	59	52	60	112
56	28	34	33	50	64
57	39	48	33	56	68
58	49	62	51	63	83
59	135	171	153	151	174
60	164	177	160	174	223
61	147	183	137	156	210
62	147	185	146	139	179
63	164	149	144	172	136
64	477	540	485	359	361
65	759	777	738	544	498
	Females (annual rate per thousand)				
55	73	83	86	92	106
56	45	47	55	54	64
57	56	62	58	61	79
58	69	61	73	68	81
59	146	160	154	165	174
60	158	182	150	202	183
61	142	171	174	178	193
62	163	170	167	159	165
63	180	188	190	165	197
64	553	580	512	416	358
65	800	800	770	520	503

Source: State of California State Teachers' Retirement System. Experience Analysis and Recommended Assumptions for Actuarial Valuation, Milliman & Robertson, Inc.(San Francisco, California 1980), pp. 22-23.

IV. Framework.

The theoretical framework outlined in this section views the individual as a utility maximizer selecting an optimal age of retirement. The framework presented below takes into consideration the intertemporal aspect of the age of retirement decision.[2]

Assume that an individual makes his retirement decision at some specific age. He acts as if he had T years to live. He expects to work full-time for "a" years, leaving T-a years for retirement. The individual can earn income, net of taxes, at a constant rate, Y, until retirement. The arguments of his utility function are C, consumption, and L, leisure. The individual will consume a constant amount over the remaining years of his life. The amount of leisure time available in each of the T years left in his life will depend on his age of retirement. For working years, leisure can be set at 0; while for retirement years leisure will take on a value of 1. Initially, the individual's wealth is given as A.[3] He is free to borrow or lend in a perfectly competitive capital market, with lending and borrowing at given rate of interest, r. Thus, the individual's circumstances can be given as

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2. A number of authors have used this approach in analyzing retirement decisions, see Burbidge and Robb (1980); Crawford and Lilien (1981); and Shoshinaki (1978).

3. Y, C, and A are measured in real terms.

$$(1) \qquad \underset{a}{\text{Max}}\ W = \int_0^a U(C,0)dt + \int_a^T U(C,1)dt$$

subject to the constraint that

$$(2) \qquad \int_0^T Ce^{-rt}dt = A + \int_0^a Ye^{-rt}dt$$

Equation (1) simplifies to

$$\underset{a}{\text{Max}}\ W = aU^1 + (T-a)U^2$$

and equation (2) simplifies to

$$(3) \qquad C(1-e^{-rt}) = rA + Y(1-e^{-ra})$$

The first order condition yields

$$(4) \qquad U^2 - U^1 = [aU_c^1 + (T-a)U_c^2]\frac{\partial C}{\partial a}$$

The $\partial C/\partial a$ can be interpreted as the increase in consumption per period as a result of postponing retirement by one year, and U_c^1 and U_c^2 are the marginal utilities of consumption in the working years and in retirement, respectively. The right-hand side of equation (4) is the increase in utility due to increased consumption over the individual's lifetime as a result of postponing retirement by one year. The left-hand side is the loss in utility of leisure due to postponing retirement by one year. This simplified framework can be used to derive the effect of a change in pension wealth on the age of retirement.

V. Approach.

A population of older public school teachers was selected for study because an analysis of the retirement behavior of this population would achieve several objectives. First, it would fill a gap in the pension literature on the behavior of public employees that belong to state and local government defined-benefit pension plans. To date, studies of retirement decision making have focused on the behavior of members of the Social Security and Civil Service Retirement systems. During the last three decades, the employment of state and local employees has grown significantly.

A second reason for studying this population is that many public school districts are in the middle of a long period of declining enrollments. This trend will result in a reduced demand for professional staff; a reduction in hiring; and an increase in the median age of staff. An aging workforce will present state and local administrators with a variety of economic and education problems; including making it increasingly difficult for teachers' retirement systems to meet future obligations. In light of this long-term trend, pension administrators and education planners are working together to develop options for changing the age composition of local school districts. Given the existence of tenure laws, one of the most frequently discussed strategies involves modifying teachers'

pension plans to make it more attractive for a typical older teacher to accept a pension at an earlier age.

Finally, the study population represents a cohort of older professional workers. To date, this segment of the labor force has not been extensively studied by researchers investigating retirement behavior.

The Data

The econometric analysis is based on a random sample drawn from the 1979 STRS actuarial valuation file. More precisely, the sample consists of members of STRS between 55 and 63 years of age on September 1, 1978. The study population was limited to members between 55 and 63 years of age because in the school year 1978-1979 members were eligible for early retirement at age 55 and normal service retirement at age 60.

The micro-data file constructed for this sample came from two sources: STRS computerized records and mail questionnaires. The STRS valuation records were used to construct pension wealth projections. The major source of data for the file came from a mail survey questionnaire administered in June 1980. Respondents were asked detailed questions about their assets and liabilities, education, health assessment, professional position, family

demographics, eligibility for pensions from public and private employers and working conditions. They also were asked questions about their spouse's education, occupation, and wage income.

Of the members sampled, approximately 58 percent responded to the mail questionnaire. Since a limited amount of personal information was available from every member's valuation record, a nonresponse rate analysis was performed to draw inferences about the representativeness of the responding sample. The nonresponse analysis indicates no critical differences in response rates by age, sex, or total service. The restricted analysis file contains 1499 members who attained age 55 by September 1, 1978, whose current or former employers are K-12 public school districts, and who have no missing data on key variables.

Variable Definitions

The variables used to estimate the age of retirement equation are defined as follows:

Dependent Variable-- Given the discussion in the preceding section, the natural choice for the dependent variable is age of retirement. In this study, retirement is viewed as accepting a pension from STRS. Furthermore, the measurement of retirement age is restricted to discrete ages.[4] For the retired subsample, this variable is measured accurately. For active members, with incomplete employment spells, this variable is measured as their actual ages, as of the survey date. The implication of this measurement technique for estimation is discussed below.

Pension Wealth-- This variable represents the expected discounted value of the STRS pension. It was constructed by projecting a benefit stream for each individual based on his final compensation and years of service as of 55 years of age. The actuarial economic assumptions used for this projection were identical to those made by STRS in their 1979 actuarial valuation: inflation rate, 5 percent; rate of wage inflation, 7 percent; and interest rate, 8.25 percent.[5]

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4. This is not a very restrictive assumption, since the labor market choices available to older teachers in California's public school system are limited by practice to full-time work or zero hours of work. For the subsample of active teachers, only 4.3 percent were in part-time positions and those positions include school district consultants and other non-teaching professionals.

5. The results reported in the next section were not sensitive to small changes in these assumptions.

Unfortunately, theory does not provide an unambiguous conclusion as to the direction of the effect of an increase in pension benefits. For the utility maximizer, a non-constant increase in pension benefits gives rise to an ordinary income effect that leads him to retire earlier; an ordinary substitution effect that also favors earlier retirement; and an intertemporal substitution effect that encourages later retirement. Thus, the effect of a pension increase on the age of retirement is ambiguous.

Other Pensions-- To take account of the effects of other expected pension income available during retirement, separate eligibility dummies are included for Social Security and private pension.

Networth-- Several researchers (Boskin 1977; Quinn 1977; and Hall and Johnson 1980) have included some measure of current wealth in their retirement equation. The econometric problem with this practice is that the measures used are potentially endogenous to the retirement equation. That is, current wealth depends on past savings and past savings depends upon labor supply. Unfortunately an exogenous measure of wealth, such as inherited wealth, is typically not available and was not available for this study population. Furthermore, the conventinal solutions (see, Greenberg and Kosters 1973; Greenberg and Hosik 1975; Kurz 1974) have not been completely successful. An early attempt to construct an instrumental variables equation

for networth did not prove to be successful. In light of these reservations, a measure of net equity is used that includes the major components of household wealth.

Health-- This is entered as a (0,1) dummy and it is obtained from answers to the question "How would you rate your health compared with other individuals of your age?"--with 1 standing for "better." There are important limitations of this type of subjective measure of health. That is, ill health is generally viewed as a socially acceptable reason for retirement and this social custom may influence an individual's rating of his health. The interpretation of this variable follows from Grossman (1972). Good health is expected to increase the age of retirement.

Imputed Earnings on Post-retirement Job-- This variable is intended to take account of the opportunity costs of remaining with the California public school system. It is anticipated that the higher are post-pension earnings, the greater the likelihood of leaving the public school system.

Marital Status-- A variable taking the value of 1 if the educator indicates that his status is "married", and 0 otherwise. Although marital status has been entered as an independent variable in many labor supply studies, there are theoretical and empirical concerns relating to the simultaneity between marriage and labor supply. It is included here on the grounds that for most older educators the marriage decision

preceded by many years the pension acceptance decision. The interpretation of this variable is: If husband's and wife's leisure are complementary, then the preference of those living with a spouse shifts in favor of leisure, but if the spouse imposes financial demands there may be a shift in favor of income. The latter is to some extent captured by the next variable.

Earnings of Spouse-- This variable captures the effect of the spouse's earnings on the market participation of a teacher. The direction of the effect of increased earnings of the spouse is ambiguous.

Dependents-- This control variable indicates the number of persons dependent upon the teacher for at least one-half of their financial support. The teacher's incentive to accept a pension should decrease with the number of his dependents; thus, a positive sign is expected for this variable.

Control Variables-- The last category of explanatory variables attempts to capture the effects of other individual characteristics. Included in this category are two dummy variables indicating sex and race and a set of dummy variables to capture the individual's professional position.

Method of Estimation

The variable of interest for this analysis is the age of retirement. It is the observed dependent variable for retired

members, but it does not represent the desired retirement age for active members. Data limitations prevent us from observing ages greater than the actual ages of active members as of June 1979. Given this censored data problem, the best available method is the tobit model. Tobin's (1958) original statistical model permitted the estimation of an underlying linear relationship when the observed dependent variable was censored below a certain limit. The model is easily generalized to the situation where the dependent variable is censored above certain known variable limits. The model can be written:

$$Y = b_0 + b_1 X_1 + b_2 X_2 + \ldots + b_m X_m$$

$$(5) \qquad S = Y - \varepsilon \text{ if } Y - \varepsilon \geq L$$

$$S = L \text{ if } Y - \leq L \ ,$$

where $\varepsilon \sim N(0, \sigma^2)$.

Then the density function for S above the limit is:

$$(6) \qquad f(S/L) = (1/\sigma) z[(Y-S)/\sigma] \ ,$$

and the probability of obtaining an observation at the limit is:

$$(7) \qquad P(S = L/X) = P(\varepsilon \geq Y-L) = 1 - Z[(Y-L)/\sigma] \ ,$$

where z is the standard normal density and Z is the standard normal distribution function. The likelihood function can be written as:

$$(8) \quad L = \prod_{i \in (i|S_i > L_i)} [(1/\sigma)\, z\, ((Y-S_i)/\sigma)] \prod_{i \in (i|S_i = L_i)} [1-Z((Y-L)/\sigma)]$$

This model can be transformed into an equivalent model with a lower limit by multiplying the dependent variable, the independent variables and the limit by -1. Second, the likelihood function does not require that all limit observations be at the same limit.

VI. Results.

In this section an empirical age of retirement model that permits variation in personal and job characteristics is estimated. Table 5 presents the means and standard deviations of the variables included in the estimated age of retirement equation.

Although empirical researchers have recognized the importance of including a measure of post-retirement earnings in an age of retirement specification, data limitations have prevented inclusion of this measure in earlier econometric formulations. In this analysis, imputed post-pension earnings are based on estimates from the earnings equation for those individuals who were working (in 1979) after receiving an STRS pension. To address the fact that this equation is fitted to the sample of workers only, an estimate of the probability that the STRS member works after receiving a pension is estimated on the sample of workers and nonworkers. This probit equation, presented in Table 6, is intended to ensure that the sample selection bias in fitting the post-pension earnings equation to the sample of workers is taken into consideration. The probit

specification includes characteristics of the individuals, and other exogenous variables that are observed for both samples. The signs of the estimated probit coefficients in Table 6 are consistent with prior expectations. Thus, the estimate on the STRS wage rate variable is negative. Previous position as an administrator exerts a positive influence on the probability of post-pension work. Also, the splined age variables conform to prior expectations about the relationship between labor force participation and age.

From these probit estimates, the inverse of Mills' ratio is formed and included in the labor earnings equation. The Mills' ratio variable corrects for the selectivity bias in the earnings equation caused by estimating this equation on only a sample of workers. Earnings are estimated as a function of labor market experience, education, health, marital status, sex, former professional position and size of the labor market. The regression estimates of the earnings equation are shown in Table 7. It is not surprising that the human capital variables, experience and education, are insignificant since the study population is a relatively homogenous group of educational professionals. Moreover, the only significant variable is the sex of the individual; males have significantly higher post-pension earnings than females.

Table 8 gives the maximum likelihood estimates of the parameters of the age of retirement model for the sample of 1499 STRS members. Almost all the variables are significant predictors of age of retirement.

The STRS pension wealth variable is statistically significant and it reveals that higher wealth appears to encourage earlier retirement. The effect of the Social Security elegibility dummy variable exhibits no apparent relationship. One explanation for this finding is that STRS members eligible for Social Security expect to receive the minimum Social Security pension. (The majority of STRS members elegible for Social Security acquired their coverage from earnings on part-time and summer employment.) Thus, the effect of Social Security elegibility on the age of retirement is negative but insignificant. In contrast, the effect of eligibility for a private pension is marginally insignificant. Private pensions tend to induce earlier retirement.

The health status variable is statistically significant and operates in the direction suggested by most previous research. Good health is associated with delayed retirement.

Individuals with higher networth appear to favor earlier retirement. This statistically significant result is consistent with findings reported by some previous studies. The effect of earnings of the spouse operates to delay retirement. The effect of imputed post-pension earnings is marginally insignificant and operates to encourage earlier retirement.

In general, the position dummy variables suggest that administrators retire later than other professional staff. The final category of explanatory variables consists of other personal characteristics. The four variables in this group are

all significant. Married members tend to retire earlier. Members with dependents still living with them tend to retire later. Also, males tend to retire later. Finally, there appears to be a race effect; whites tend to retire earlier than minorities.

Because the estimated tobit parameters are not directly interpretable, it is useful to calculate effects of changes in STRS members' pension or income variables on retirement ages. Table 9 presents the results of these changes. For example, the largest effect results from increasing STRS pension wealth by $5,000. This results in a 0.23 year decrease in the age of retirement. In contrast, the effect of being eligible for Social Security is negligible.

TABLE 5

Means and Standard Deviations of Variables

Variable	Description	Mean	Standard Deviation
P55B	present value of STRS benefits ($1,000's)	37.263	20.578
PRVPEN	1, if eligible for private pension	0.068	0.252
ELIGSS	1, if eligible for Social Security	0.383	0.486
NETWRT	networth ($1,000's)	190.691	160.957
GDHLTH	1, if health rating better than others	0.596	0.491
MARSTA	1, if married	0.756	0.430
DSEX	1, if male	0.430	0.495
WHITE	1, if white	0.941	0.235
TOTDEP	total number of dependents	0.438	0.813
SEARN	earnings of spouse ($1,000's)	7.933	11.628
REGTCH	1, if classroom teacher[a]	0.626	0.484
SPEDTR	1, if special education teacher	0.065	0.247
PUPLSV	1, if pupil services personnel	0.116	0.320
OTHPOS	1, if other professional position	0.070	0.255
PEARNM	imputed post-pension earnings	7591.370	3144.770

[a] The reference category for the position categorical variables is district-level administrator.

TABLE 6

Estimates of the Probit Parameters Determining the Probability of Working After Accepting an STRS Pension

Coefficients	Maximum Likelihood Estimates	Standard Error	t Statistic
Constant	-12.20158	2.29868	-5.308
Wage55	-0.00468	0.00222	-2.109
Goodhlth	0.00716	0.08231	0.087
Sex	0.19706	0.09140	2.156
Baseage	0.20415	0.03907	5.226
Age60	-0.35895	0.13275	-2.704
Admin	0.36880	0.12220	3.018
Married	0.06203	0.10030	0.618
Deplt18	0.09064	0.16181	0.560
Purb70	-0.00277	0.00267	-1.038
Pdensc	-0.00002	0.00003	-0.612
-2 ln of likelihood	75.44888		

Note: There are 1,499 observations, of whom 243 work.

Key:

- Wage55 = Daily STRS wage rate at age 55
- Goodhlth = 1, if health is better than persons of same age and sex
- Sex = 1, if sex is male
- Baseage = 60, if age as of September 1978 is greater than or equal to 60
- Age60 = 1, if baseage is greater than or equal to 60
- Admin = 1, if position is administrator
- Married = 1, if marital status is married
- Deplt18 = 1, if there is a dependent under 18 years of age in household
- Purb70 = Percent urban of county in 1970
- Pdensc = Population density of county in 1979

TABLE 7

Labor Earnings Regression for Members of STRS that Have Accepted a Pension and Are Working in 1979

Coefficients	Parameter Estimates	Standard Error	t Statistic
Constant	7.01626	11.24901	0.624
Exper	0.02176	0.03346	0.650
Experaq	-0.00019	0.00124	-0.155
Yrseduc	0.17062	1.27002	0.134
Yrseducaq	-0.00504	0.03602	-0.140
Sex	0.81534	0.16874	4.832
Married	-0.25773	0.18726	-1.376
Goodhlth	0.11546	0.14121	0.818
Admin	0.08439	0.22631	0.373
Purb70	0.00649	0.02062	0.315
Purbaq	-0.00012	0.00017	-0.686
Pdensc	0.00033	0.00018	1.787
Pdenscaq	-2.09053e-08	1.20740e-08	-1.731
Mills	-0.12481	0.32844	-0.380

Note: The dependent variable is the natural logarithm of annual earnings. MSE = 0.938; R-square = 0.301; N = 233.

Key:

Exper = Years of experience
Experaq = Square of years of experience
Yrseduc = Years of schooling
Yrseducaq = Square of years of schooling
Sex = 1, if sex is male
Married = 1, if marital status is married
Goodhlth = 1, if health is better than persons of same age and sex
Admin = 1, if position is administrator
Purb70 = Percent urban of county in 1970
Purbaq = Square of percent urban of county in 1970
Pdensc = Population density of county in 1979
Pdenscaq = Square of population density of county in 1979
Mills = Mills' ratio

Table 8

Estimates of the Tobit Parameters Determining the Age of Retirement

Variable	Coefficient	Standard Error	t Statistic
Constant	66.641	1.135	58.717
P55b	- 0.463e-01	0.731e-02	- 6.336
Prvpen	- 0.756	0.438	- 1.726
Netwrt	- 0.156	0.672e-03	- 2.329
Eligss	- 0.284e-01	0.253	- 0.112
Gdhlth	0.901	0.236	3.826
Marsta	- 2.025	0.337	- 6.009
Dsex	2.334	0.597	3.912
White	- 1.973	0.603	- 3.274
Totdep	0.588	0.166	3.541
Searn	0.332e-04	0.104e-04	3.195
Regtch	- 1.096	0.409	- 2.681
Spedtr	- 1.158	0.585	- 1.980
Puplav	0.192	0.495	0.388
Othpos	- 0.483	0.582	- 0.830
Pearnm	- 0.147e-03	0.889e-04	- 1.651
Sigma	3.265	0.100	32.529
Ln of the likelihood function	-1723.010		

TABLE 9

Response of Age of Retirement to Change in Income

Variable	Description of Change	Change in Age of Retirement
STRS pension wealth	$5,000 increase	-0.23
Social Security	Eligible vs. ineligible	-0.01
Private pension	Elibible vs. ineligible	-0.05
Networth	$20,000 increase	-0.03
Spouse earnings	$1,000 increase	-0.03e-03
Post-retirement earnings	$1,000 increase	-0.15

VII. Implications.

A comparison of the results of this study with those of other studies reveals that there is general agreement that pension benefits significantly affect the age of retirement. This finding suggests that early retirement provisions can be used to accelerate retirement from state and local employment. Originally, many of the early retirement provisions were introduced to allow individuals who were forced by poor health or some other condition to leave their jobs before the normal age of retirement. Moreover, the lower level of benefits due to early retirement was intended to discourage early withdrawal for those able to work until the normal age of retirement.

If policymakers desire to use early retirement provisions to increase the rate of voluntary withdrawals, then they must consider stronger economic incentives than heretofore have been provided. One approach would be to entirely eliminate the actuarial reduction for early retirement. Alternatively, state and local governments could provide a severance bonus for voluntary early retirement. This latter option has been used effectively by private industry to increase voluntary quit rates. For example, the effect of eliminating the actuarial reduction factor for early retirement decreases the average age of retirement of STRS members by 0.74 years. The effect of increasing STRS pension wealth by the equivalent of one-year's severance pay decreases the age of retirement by 0.79 years. These incentives could be combined with other supplemental payments, such as continuation of medical and life insurance.

Another implication of this study is that health does indeed have an effect upon retirement decisions. Individuals will delay retirement if they are in good health. This finding needs to be taken into consideration when designing future early retirement programs.

Finally, policymakers should be interested in the effect of future earnings on a post-retirement job, which is to induce earlier retirement. This finding suggests that state and local agencies should consider offering employment counseling and retraining payments as a means of encouraging earlier retirement.

References

Bixby, Lenore. "Retirement Patterns in the United States: Research Policy Interaction," Social Security Bulletin, Volume 39, Number 3 (August, 1976), 3-19.

Blinder, A., Gordon, R. and Wise, D. "Reconsidering the Work Disincentive Effects of Social Security," National Tax Journal, Volume 33 (December, 1980), 431-442.

Boskin, Michael. "Social Security and Retirement Decisions," Economic Inquiry, XV (January, 1977), 1-25.

Boskin, Michael and Hurd, Michael. "The Effect of Social Security on Early Retirement," Journal of Public Economics, (December, 1978), 361-377.

Burbidge, John B. and Robb, A. L. "Pensions and Retirement Behaviour," Canadian Journal of Economics, XIII, Number 3 (August, 1980), 421-437.

Burkhauser, Richard V. "An Asset Maximization Approach to Early Social Security Acceptance," In Institute for Research on Poverty Discussion Papers. Madison, Wisconsin: University of Wisconsin- Madison, 1977.

Burkhauser, Richard V. and Turner, John A. "Can Twenty-Five Million Americans Be Wrong? A Response to Blinder, Gordon, and Wise," National Tax Journal, 1981.

Burtless, Gary and Hausman, Jerry. "Individual Retirement Decisions Under An Employer Provided Pension Plan and Social Security," In National Bureau of Economic Research Working Paper Series Cambridge, Massachusetts, 1981.

Clark, Robert L. and Johnson, Thomas. Retirement in the Dual Career Family A Report to the Social Security Administration, 1980.

Crawford, Vincent P. and Lilien, David M. "Social Security and the Retirement Decision." Quarterly Journal of Economics, (August, 1981), 505-529.

Greenberg, David H. and Hosek, James R. Regional Labor Supply Response to Negative Income Tax Programs. A Report to the Economic Development Administration, 1976.

Greenberg, David H. and Kosters, Marvin. "Income Guarantees and the Working Poor: The Effect of Income-Maintenance Programs on the Hours of Work of Male Family Heads," In Cain, Glen and Watts, Harold. Income Maintenance and Labor Supply: Econometric Studies, 1973, 14-101.

Grossman, Michael. "On the Concept of Health Capital and the Demand for Health." Journal of Political Economy, Volume 80 (April, 1972), 223-255.

Hall, Arden and Johnson, Terry R. "The Determinants of Planned Retirement Age." Industrial and Labor Relations Review, Volume 33, Number 2 (January, 1980), 241-254.

Mitchell, Olivia S. and Fields, Gary S. "Economic Incentives to Retire: A Qualitative Choice Approach." In National Bureau of Economic Research Working Paper Series. Cambridge, Massachusetts, 1983.

Pellechio, Anthony J. "The Effect of Social Security on Retirement," In National Bureau of Economic Research Working Paper Series. Cambridge, Massachusetts, 1978.

Quinn, Joseph F. "Microeconomic Determinants of Early Retirement: A Cross-Sectional View of White Married Men." Journal of Human Resources, Volume 12, Number 3 (Summer, 1977), 331-356.

Sheshinski, Eytan. "A Model of Social Security and Retirement Decisions." Journal of Public Economics, December, 1978.

Steiner, Peter O. and Dorfman, Robert. The Economic Status of the Aged. Berkeley: University of California Press, 1957.

Tobin, James. "Estimation of Relationships for Limited Dependent Variables," Econometrica, Volume 26, Number 1 (January, 1958), 24-36.

Wentworth, Edna C. Employment After Retirement. U.S. Department of Health, Education and Welfare, Social Security Administration, Office of Research and Statistics, Research Report 21, 1968.

Appendix

Empirical Studies of Retirement Decision

Study	Population	Sample Size	Data Sources	Dependent Variable	Specification
Boskin and Hurd (1978)	White males age 62-65 in 1969	1,000	LRHS, 1969	3 state prob.--working, semiret., ret.	Logit
Burtless and Hausman (1980)	Federal empl. between 54-61, 1976	4,156	Federal employment and Soc. Sec. records, 1977	3 state Federal employ., private employ., ret.	Cond. probit
Clark and Johnson (1980)	Married couples, husband age 58-63 in 1969	7,043	LRHS, 1969, 1971, and 1973	Prob. in labor force	Simultaneous logit
Gordon, Blinder, and Wise (1980)	White men, not self employed, age 58-67	15,981	Pooled LRHS 1969, 1971, and 1973	Prob. of being ret.	Maximum likelihood
Mitchell and Fields (1983)	Males age 60-68 in 1978	8,733	Benefits Amounts Survey	3 state prob.--working, semiret., ret.	Ordered logit
Pellechio (1978)	Married men age 60-70, not covered by public ret. plans	593	CPS-IRS-SSA Exact Match File, 1973	Prob. of being ret.	Probit
Quinn (1977)	White married men age 58-63, not self-employed, farmers, or seriously ill	4,354	LRHS, 1969	Prob. in labor force	Logit